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THE IMPACT OF SMARTPHONE ADOPTION ON CONSUMERS' SWITCHING BEHAVIOR IN BROADBAND AND CABLE TV SERVICES

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ABSTRACT

The emergence of smartphones has brought a technology disruption to the telecom business. Due to the various services offered in association with smartphones, people can surf the web or watch TV. This research is related to telecom services overall, and has the goal of finding the impact of smartphone adoption to consumers' switching behavior in broadband and cable TV services. This research adopts a quasi-experimental design and investigates the causal effect of smartphone service adoption on broadband and cable TV service choices. The data collection involves five years of consumer service subscriptions in a Singaporean telecommunications company. I tested for evidence on the impacts of the different treatment effects based on service upgrade and downgrade behavior by the company's existing customers. My preliminary analysis suggests that smartphone users tend to downgrade their broadband and cable TV services less than feature phone users. This implies that there is no substitution effect between smartphones, on the one hand, and broadband and cable TV services, on the other. I am currently working on a statistical model to capture the complementary effects of smartphone adoption.

KEYWORDS

Telecom services, consumer choice, quasi-experimental design, computational social science, substitution, complementarities

1. INTRODUCTION

Since the first commercial mobile phone was launched in the 1970s, mobile technology has created game-changing disruptions in the telecommunication industry. Evolution in the mobile technology area is usually referred to in terms of generations (G) (Fling 2009). With each generation, there is not only an increase in the speed of communication services, but also add some new features typically are added. For example, in the 1990s, short message service (SMS) capabilities were introduced with 2G technology. After 2G technology was introduced, but before 3G technology came

along, consumers were able to use various new features, such as packet-switched data services or cameras in their mobile phones.

When the first smartphone was introduced in the United States, the device did not attract much attention from consumers.¹ As mobile devices and their operating systems have advanced, smartphones adoption has increased faster than any other technology in the telecommunication industry. Based on survey from Pew Internet, smartphones have outnumbered feature phones since 2012 (Wagstaff 2012). The introduction of smartphones has played an important part in changing the consumer experience in retail telecom services. The original concept of smartphones combined the function of a PDA with a mobile phone. Due to this characteristic, smartphones not only provide original telephone features, but also various functions that can be done with other devices, such as PDAs or computers. With the expansion of wireless network bandwidth, other features like online video services have also become available. These new functions make smartphones different from regular feature phones. According to "Techsurvey VIII" by Jacob Media², smartphone and feature phone owners show significant differences in the mobile phone service they use. The similarities between smartphone and feature phone owners consist of their use of voice call and text message services. Smartphone owners can surf the Internet and watch TV using these devices, and feature phones don't support this very well.

The coverage of retail telecom services with smartphones may affect mobile phone services, as well as other telecom services such as broadband and cable TV. The key mobile phone features available in smartphones are associated with data usage. According to a report from Morgan Stanley Research, the critical factors that drive the growth of mobile Internet traffic are web surfing and video viewership (Meeker et. al. 2009). This implies that there is likely to be an impact of smartphone use on broadband and cable TV services.

By considering the introduction of smartphone services as a major shock in the retail telecom services sector, my research aims to investigate whether smartphone adoption affects consumer choice of broadband and cable TV services. The effects of mobile technology have been a popular topic in information and communication technologies (ICT) research. Previous studies on mobile technology have mainly focused on the substitution effect of mobile phone services for fixed-line telephone services (Srinuan 2012). However, due to the lack of data availability, most of the earlier work was not able to use individual-level data. So it was mostly constrained to examining the relationship between services that have the same functions, such as voice calls.

From an academic perspective, my research is intended to explore the relationship between smartphone and broadband, and smartphone and cable TV services. These

services have been undergoing digital convergence, especially through the introduction of smartphone (Parsons 2009), so this research is also intended to reveal the possibilities for exploiting new opportunities related to other service sectors. With the emergence of multi-play service bundling, my research also has the potential to provide implications for new marketing strategies in the retail telecom business.

To address the issues related to smartphone effects, I am conducting research that uses a quasi-experimental design as the basis for a preliminary analysis. Quasi-experimental research design is a popular method for finding causal relationships between different treatments and the resulting outcomes. Due to the lack of random assignment in the historical data that I have access to, my approach is to employ a treatment involving introduction of smartphone service, and within-subjects variable (time – before and after the introduction). Using two-by-two mixed design, this research observes the switching rate of broadband and cable TV services between the treatment and control groups, and before and after the introduction of smartphone services.

For this analysis, I will observe societal-scale consumer service subscription data for a large Singaporean retail telecom services company. This research is based on work that I have been conducting at the Living Analytics Research Centre (LARC) at Singapore Management University. Most of the projects in LARC use experimental methods and supporting tools for analyzing business, consumer and social insights. With collaboration from the sponsor, I have been able to collect truly large-scale data on consumer behavior in retail telecom services for my research. The availability of this kind of “big data” is one of the strengths of this research. Due to the lack of consumer-level data, previous research on the impact of mobile technology relied on much less details measures, including the penetration rate of mobile phones in a country, or overall measures of diffusion in different years, and so on. From this perspective, my analysis work involving the use of big data will provide important insights on key managerial issues in telecommunication services.

The rest of this research overview is organized as follows. Section 2 reviews previous research on substitution effects and complementarities that arise in the area of mobile technology. It also provides theoretical perspectives from the literature to identify the impact of smartphone adoption on other telecom services. Section 3 describes my quasi-experimental design for the analysis of the data I collected. Information on the context and data are described in Section 4. Then, Section 5 presents my preliminary results from the quasi-experiment. Finally, I conclude with an overview of the importance of my research, my preliminary findings and my future research plans.

2. LITERATURE REVIEW

This section consists of two parts. The first part reviews the findings of the previous research on the impact of mobile technology in the telecommunications industry. The other part reviews relevant knowledge on smartphone usage behavior to identify the possible linkage between smartphone adoption and consumer subscriptions to other telecom services, such as broadband and cable TV.

2.1 THE EFFECTS OF MOBILE TECHNOLOGY ON RETAIL TELECOM SERVICES

There are several papers that have discussed the relationship between mobile and fixed-line telephone services. Most of the discussions in this context have focused on the substitution effects of mobile phones to fixed-line telephone services. Sung and Lee (2002) conducted an empirical analysis in the Korean telecom market. They showed that an increase in the number of mobile telephones results in a reduction in the number of fixed-line telephone service subscriptions. Likewise, most research on the impact of mobile phones on fixed-line telephone services has empirically validated this substitution effect in terms of the cross-elasticity of demand between them (Ahn and Lee 1999; Rodini et. al. 2003; Garbacz and Thomson 2005; Narayana 2008; Grajek and Kretshmer 2009). The substitution effect can be explained by a relative decline in mobile network costs, network effects, and quality improvement of mobile services (Yoon and Song 2003). On the other hand, others have discussed the complementary effects of mobile phone services. Albon (2006), for example, tried to explain the complementarities in terms of the differences between what the calling and receiving party pay based on the various pricing mechanisms that have been used. The research in this context used national-level penetration rates for mobile and fixed-line telephone services, and examined the cross-elasticity of demand between these two services.

Due to the short history of mobile broadband services availability in the market, there have been not many studies on the relationship between fixed-line and mobile broadband services, compared with the issue of fixed-line and mobile phone services substitution where my interests lie. Nevertheless, several research papers and industrial reports suggest some predictions about the relationship between mobile and fixed broadband. For example, Srinuan et. al. (2012) observed the growth of mobile and fixed broadband services in the Swedish market. Price in the Swedish market is a major factor for broadband connections, which is consistent with the previous findings from the research on telephone services. The authors argue that mobility, compatibility, and quality of mobile broadband services are the important factors that determine the substitution effect of mobile to fixed broadband services. There exist several studies predicting the complementary effects of mobile Internet services on broadband Internet services based on conceptual assessment (Nielsen and Fjuk 2010) and survey

research (de Reuver et. al. 2012).

Based on the current status of research on the impact of mobile technology, this research shows some differences in contrast to previous research. My main focus is to find the impact of smartphone adoption on consumer switching behavior in broadband and cable TV services. Compared with previous studies that used aggregate data to examine the impacts of mobile phone technology, my research examines consumer behavior. I also examine the relationship between smartphone adoption and two other areas of retail telecom services that are not directly related to smartphone services. There are several individual-level studies on the impact of mobile phone technology. Some of them focused on the relationship between SMS and voice call services (Grzybowski and Pereira 2008; Gerpott 2010; Kim et. al. 2010), and voice call and data services (Niculescu and Whang 2012). These services are a subset of mobile phone services. The relationship among mobile, broadband, and TV services has gained attention with multi-play services in the telecom business (Research and Markets 2011).

2.2 SERVICE CONVERGENCE DUE TO THE INTRODUCTION OF SMARTPHONE

One of the remarkable things with smartphones is that they include various tools such as email clients, web browsers, and video players (Charlesworth 2009). All these functions build on what can be done with computers and TV. Most research on smartphone usage has examined the behavior associated with computers and TV, as a result. For example, Yelton (2012) found that most smartphone owners use laptops and smartphones for wireless Internet access rather than use smartphones only. Parsons (2009) showed that mobile broadband services are often used in the home or the office, rather than on buses or trains. The evidence suggests the presence of a complementarity involving smartphones and broadband services. The past research also has reported consistent findings on consumer behavior related to TV viewing through mobile phones, and that most tablet owners use their tablets while watching TV. Perhaps tablet owners use their devices to find relevant information on the TV programs they are interested in watching, and so smartphones may offer complementarities for consumption.

3. RESEARCH CONTEXT AND QUASI-EXPERIMENTAL DESIGN

3.1 RESEARCH CONTEXT

The research sponsor provides a full range of mobile, broadband, and cable TV services in Singapore. Mobile services include “feature phone” and “smartphone” services. These types of services provide the typical mobile services, such as voice

calls and text messages. The major difference between these two types is whether they provide a mobile data service. Smartphone services were introduced in Singapore in December 2009, so consumers who adopted smartphone services after that time would also have been able to use data services and to enjoy such things as Facebook and YouTube. Broadband services include fixed-line and fiber-optic capabilities that were sold as separate services. Fiber-optic broadband services generally provide more bandwidth than fixed-line Internet services, but both types have overlapping service capabilities. The cable TV services of the research sponsor involve the provision of consumer access to many different channels that are packaged as distinct service bundles. In the broadband and cable TV services contexts, the idea of a “service upgrade” means that the consumer will switch to a service that offers better quality, may be more expensive, has more channels, and so on. A “service downgrade,” in contrast, means that the consumer switches to a lower quality, lower functionality, and possibly cheaper service.

3.2. QUASI-EXPERIMENTAL DESIGN

I next want to describe how I designed the quasi-experiment. My first step was to identify the impact of smartphone adoption on consumer switching behavior in broadband and cable TV services. I use a quasi-experimental design to investigate the differences in behavior between feature phone and smartphone users. The development of an experimental design is an effective approach in social science research to find the causal effect of an experimental treatment. To maximize “internal validity,” which is an assessment of how well the scientific method provides a reading on what the data that are “internal” to the setting under study can tell us, participants should be randomly assigned based on different levels of the independent variables (Shadish et. al. 2002). Due to some practical reasons, however, it is not always possible for researchers to randomly assign participants to the control and the treatment groups (Remler and Van Ryzin 2011). A quasi-experimental design can be used when researchers cannot achieve full randomization of the subjects in the experimental treatment groups. In our retail telecom services setting, it was impossible for us to control the timing of the introduction of smartphone in Singapore, nor could we randomize consumer service choices for this analysis. Thus, my choice in this research was to adopt a quasi-experimental design.

The main purpose of this preliminary analysis is to gain some insights about the relationship between smartphone adoption and switching behavior in broadband and cable TV services. For this reason, I consider the introduction of smartphone services in the market as the treatment effect in the quasi-experimental design.

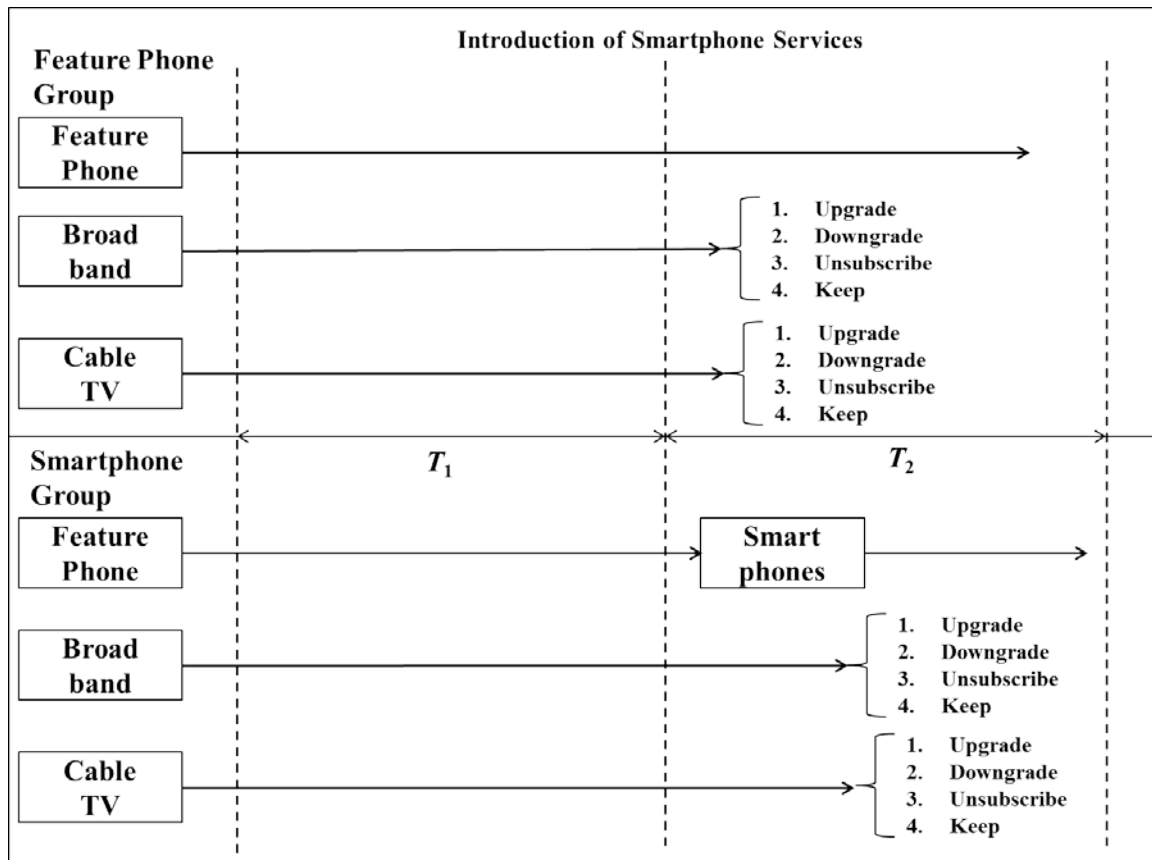
Based on this idea, the next step is to define the control and treatment groups in this

analysis. The control group includes consumers who used feature phone services before the introduction of smartphone services, and continued to use them afterwards. I call this the "Feature Phone" group. This group is comprised of consumers who were not affected by the treatment. A second treatment group, the "Smartphone" group, contains consumers who subscribed to feature phone services before the introduction of smartphone services, and then switched to smartphone services after they were introduced. With this treatment, it is possible to make a comparison between the switching rates for broadband and cable TV services for the two groups.

Because it was not possible to implement random assignments in this experimental design, an appropriate alternative approach is to add time as a within-subject variable. This is referred to as a "mixed method" in experimental design. The quasi-experiment in this research further involves a 2×2 design. I will include time, with the treatment of service plan subscriptions before and after the introduction of smartphone services, as well as the "Feature Phone" and "Smartphone" groups. I also will use repeated measures for the consumer switching rate between broadband and cable TV services. Figure 1 shows the overall design.

4. DATA DESCRIPTION

Based on the above design, my approach is to randomly select consumers that satisfy the conditions for membership in the "Feature Phone" group and the "Smartphone" group. December 2009 was the month that smartphone services were introduced into the Singapore market. To study consumer behavior for telecom service subscriptions, I have access to sixty months of data, centered on December 2009. So there is a thirty-month period before the entry of smartphone services and another thirty-month period after the introduction of smartphone service. I will refer to the two periods at T_1 and T_2 – in other words, "before" (1) and "after" (2) the smartphone services entry.

FIGURE1. A QUASI-EXPERIMENT WITH A MIXED METHOD

Note: T_1 = time before smartphone services entry; T_2 = time after smartphone services entry

Consumers in the “Feature Phone” group subscribed to feature phone services prior to the entry of smartphone services (T_1), and kept using them afterwards (T_2). On the other hand, consumers in the “Smartphone” group subscribed to feature phone services before smartphone services became available, but thereafter they switched to smartphone services. Thus, every consumer in the “Smartphone” group will have been affected by the treatment – in other words, smartphone adoption – after smartphone services were introduced. Randomized selection of smartphone service consumers resulted in 1.7% of eligible consumers, and for feature phone service consumers, the corresponding percentage was 2.3% of eligible consumers. Although I am not permitted to disclose the exact number of observations by my corporate sponsor, nevertheless I can say that the order of magnitude of observations in each cell of the 2×2 mixed model is greater than 10,000 and less than 50,000 observations.

Although this research is designed as a quasi-experiment, I also checked to see whether there was a gain in the fidelity of my results if I were able to use a fully-randomized design for the two groups. To test whether there are differences between the control and treatment groups, I explored variables for age, gender, dwelling type and region of residence, since they are relevant demographic variables. The use of a t-test permits the identification of the differences in the average ages between the two groups. The application of a χ^2 test is appropriate for the remaining categorical variables. The t-test and χ^2 test showed that there is no difference in age and gender across the groups, but they tend to live in different dwelling types and have diverse regions of residence. This implies that membership in the groups is not entirely random assignment. My mixed design is intended to address this issue.

To identify the impact of smartphone introduction on broadband and cable TV services, the key outcome measures are the downgrade and upgrade percentages for broadband and cable TV services. The downgrade percentage identifies the substitution effect related to the introduction of smartphones. The upgrade percentage shows the extent of the complementarities that are pre-sent. With a 2×2 mixed design, there are four different upgrade and downgrade percentages that can be observed, based on the related between-subject and within-subject variables. Figure 2 shows my framework for the measurements.

FIGURE 2. OUTCOMES IN THE QUASI-EXPERIMENT

		Within-subject variable (Time)		Outcomes
		Before the introduction of smartphones	After the introduction of smartphones	Difference between time period
Between-subject variable (Group)	Feature Phone Group	Upgrade percentage (A_1)	Upgrade percentage (A_2)	$\Delta A = A_2 - A_1$
		Downgrade percentage (B_1)	Downgrade percentage (B_2)	$\Delta B = B_2 - B_1$
	Smartphone Group	Upgrade percentage (C_1)	Upgrade percentage (C_2)	$\Delta C = C_2 - C_1$
		Downgrade percentage (D_1)	Downgrade percentage (D_2)	$\Delta D = D_2 - D_1$

The upgrade and downgrade percentages of broadband and cable TV services in each group are repeated measures: they can be captured twice – once before and once after the introduction of smartphones. The reason of measuring them repeatedly is to observe the difference between them before and after smartphones were introduced. The observations in each group will provide evidence for whether there is an impact of this in the treatment group. For example, if the down-grade percentage of broadband services in the “Smartphone” group increases more than in the “Feature Phone” group after smartphones were introduced, then there will be evidence for a substitution effect between smartphones and broadband services. On the other hand, if the upgrade percentage of cable TV services in “Smartphone” group increases more than in the “Feature Phone” group after the introduction, then this will be evidence for the possibility of complementarities for the introduction of smartphones with respect to cable TV services.

5. RESULTS

There are several findings that emerged from the preliminary analysis. Due to the non-disclosure agreement with the sponsor, I am not able to reveal the actual numbers that I obtained. Nevertheless, I am able to compare the difference in the results between the two time periods, and report that there is an increase in the downgrade percentage for broadband services in the “Feature Phone” group. However, the “Smartphone” group did not show a significant increase or decrease of the downgrade percentage after the introduction of smartphone services. This implies that smartphone service adoption does not result in a substitution effect with respect to broad-band service choices that consumers may make. From this result, it appears that the smartphone services that result in the use of data cannot readily replace the capabilities of broadband services. I obtained similar results from my analysis of upgrade percentage for the data set. The overall result is that smartphone users generally tend to retain their broadband services more than feature phone users do.

The results in cable TV services show similar findings to the one in broadband services, which shows the relative difference between observations. In overall, smartphone users do not show much difference between the two periods. However, feature phone users show significant increase in both downgrade and upgrade percentages after the introduction of smartphones. This result can give an implication that there is no substitution effect of smartphone adoption to broadband and cable TV services, but cannot tell whether there exists a complementary effect.

6. CONCLUSION

Based on the results of the quasi-experimental analysis, it appears that there is no substitution effect for smartphone adoption with respect to broadband and cable TV services. The results also show that smartphone users exhibit a higher retention rate for these two services than feature phone users do. Due to the limitation of my preliminary analysis and the quasi-experimental design I employed, other factors that may affect consumer switching behavior cannot be ruled out. In spite of these limitations, the results still have some implications about the relationship between smartphone adoption, and broadband and cable TV services. Based on my data and the preliminary experimental work and analysis, it appears that mobile Internet and TV may be able to replace desktop Internet and cable TV services. The above result shows the possibility of a complementary effect from smartphone adoption on other retail telecom services. The next step, as a result, is to give greater consideration to the role of complementarities in the setting that is explored.

For the further steps, this research plans to develop a statistical model to validate the effect of smartphone adoption to switching behavior in other services. Instead of using an aggregate percentage of switching, this research will use individual level analysis for capturing individual characteristics such as years of contract left, or number of mobile phones that a customer holds. Compared with that previous research mostly focused on the price effect of mobile technology to telephone services, this research will more focus on the perspective of service characteristics. Smartphone services make people use the internet or video services on their mobile devices, which can be done with traditional devices such as computers and TV. However, several limitations of technology might differentiate the quality of services in smartphones from that in other devices. For example, low bandwidth of smartphones, compared with the one of fixed broadband, can limit consumers' use of smartphones. In case of video service, smaller screen in smartphones can also restrict consumers to watch just news. Based on this idea, this research will identify how the impact of smartphone services can differ from the quality of services and individual mobility.

7. ACKNOWLEDGEMENT

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ENDNOTES

¹ <http://en.wikipedia.org/wiki/Smartphone>

² <http://jacobsmediablog.com/2012/05/15/gone-mobile-3/>